WFL Publisher
Science and Technology

Journal of Food, Agriculture & Environment Vol.2 (3&4) : 87-90. 2004 *www.world-food.net*

Agriculture

Resource use efficiency of small-holder farmers: The case of cassava producers in Cross River State, Nigeria

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Received 11 May 2004, accepted 22 August 2004.

Abstract

This paper examined the contributions of small-holder cassava farmers to the food security situation in Nigeria. Specifically, the study analyzed the efficiency of use of resources among the cassava farmers. Collected data were analysed using the ordinary least squares (OLS) regression analysis in addition to allocative efficiencies and resources elasticities. The linear model was the best fit having an R^2 of 0.86 with variables farm size, labour and capital. While farm size and capital were significant, labour was not. There was also an inverse relationship between capital and output. The allocative efficiency index for land was found to be high while that of capital and labour was low. The elasticity estimates showed that the resources were inelastic. Strategies aimed at increasing farm size will significantly improve resource efficiencies of small-holder cassava farmers and these still have a significant role to play if we are to achieve food security in Nigeria.

***Key words*:** Capital, farm-size, food security, labour, output.

Introduction

The discussions on small-holder farmers in Nigeria remain very important because of their dominance in the Nigerian farming industry. They produce 95% of the food consumed in Nigeria, 87% of agricultural exports and provide employment for 70% of the population directly or indirectly [3]. The implication, therefore, is that these small-holder farmers manage a vast proportion of the productive agricultural resources of this country in terms of land, labour, capital and management.

Cassava is a very important crop in Nigeria deriving from the extensive use of the various products and by-products as staples to most Nigerians. The consumption of cassava cuts across all parts of the country. Its adaptability to climatic and soil conditions even in marginal soils has endeared cassava to most people that have to do continuous cultivation on limited available land. The yields of cassava according to IITA [9] are mostly above 22.0 tons per hectare even on poor soils, which gives it superior advantage over other tuber crops like yams, cocoyams and potato. The general acceptance of cassava and its products to all classes of Nigerians on its own draws close attention to the producers of cassava.

This paper seeks to compliment the various efforts of research in improving the production of cassava in Nigeria. It serves to update literature on resources used in cassava production and the efficiency of allocation among Cross River State small-holder farmers. Specifically, the paper examines how small-holder cassava farmers in C. R. S. utilize available resources for production. It determines the relationship between output and factors like farm size, labour and capital in cassava production. It also estimates allocative resource efficiencies as well as elasticities in cassava production and finally suggests ways for improvement to attain food security using cassava production.

Definition of Terms/Concepts

Allocative efficiency: This is achieved when we cannot improve or increase total output of an enterprise [7, 19]. It is also described as the point where marginal value product (MVP) equals the factor price (Pxi) (ie $MVP_{xi} = Pxi$) [13].

Agricultural productivity: Index of ratio of value of total farm output to the value of total farm input used in the production process. We could have partial factor productivity or total factor productivity [2, 17].

***Production efficiency*:** Achieved when no additional output can be obtained by increasing cost or sacrificing some other goods. It is achieved through efficient resource allocation [6, 16].

***Elasticity*:** This is the degree of responsiveness of output to changes in input.

Methodology

This paper used primary data collected from small-holder cassava farmers in Cross River State. A total of 100 farmers were selected using stratified random sampling techniques. These were interviewed using a set of questionnaires. Questions bordered on inputs used with their proportions and output. The collected data were analyzed using the ordinary least squares (OLS) regression estimation technique. This was found to be suitable and used according to Erik et al.[8] and Alimi [5]. The production function was used in three functional forms from which the lead equation was chosen on the basis of the values of the coefficient of multiple determination (R^2) as well as the signs and significance of the regression parameters.This was stated implicitly as: $Y = f(X_1 X_2 X_3)$, where Y = total output of cassava (kg), X_1 = farm size (ha), X_2 = labour in man-days, X_3 = Capital (₦).

Allocative efficiency of each parameter was estimated using an index with formula: Kxi = biPy/Pxi, where Pxi = unit price of input (₦), Py = unit price of output (₦), Bi = marginal productivity of the input, Kxi = allocative efficiency index of the input.

The elasticities of production were estimated using the formula: Epxi = biXi/Y where bi = the first derivative of the production function, X_i = mean value of the ith input, Y = mean value of cassava output, Epxi = elasticity of production of the ith input.

Results and Discussion

The results of this study showed that small-holder farmers were able to combine resources and had output of normal-sized cassava tubers. Inferences can be drawn from the various analyses carried out. These were however, divided into socio-economic characteristics, determinants of output and efficiency measures.

Socio-economic characteristics: These are discussed under education, farm size, family size, sex, age, cultivar type planted and source of finance/credit as they affect cassava production (Table 1). Table 1 shows the mean percentages and standard deviation of the listed variables.

Education: The educational status of the cassava farmers shows that 21% of them had no formal education and 25% had only primary education (Table 1). Those that have secondary education were of the highest proportion and represented 36% of the sampled farmers. The least group of 3% included those with higher education beyond the secondary level. The implication here is that a high proportion of these farmers who can read and write owned cassava farms and it could be easier to transfer research results for sustainable food security as they can easily accept to adopt research findings.

Farm size: The farms were generally of small sizes with the range of 0.01 to 0.05 ha being 75% and 0.05 to 0.99 being 19%. This means that the percentage of farmers having below one hectare was 94%, which was also the target population of this study.

Family size/sex: The largest group had between six and ten members as it constituted about 50% of the population sampled. The female population was more involved in cassava production because about 54% of them owned cassava farms. In fact, this group of farmers was known to cultivate and own farms outside the common family farms. This was probably because cassava production was the major source of income for this group.

Age: The age groups of the farmers were mostly between 15 and 45 years. The age range of 15 to 30 years and 31 to 45 years each had 40% of the respondents while those above 45 years were only 20%. The predominance of the younger age bracket in cassava production is an indication of the ease of entry into cassava production enterprise. The enterprise is not very capital intensive, so younger persons can easily start cassava production with little capital and their own labour.

Cultivar planted: The improved cassava varieties have been introduced across the state and 85% of the respondents had access to the varieties. Only 15% of the respondents had no access to improved varieties. It was also easy to obtain improved varieties from neighbour's farms at no explicit cost.

***Credit/finance source*:** The finance of the farmers mostly came from personal savings (54%) while family sources and Osusu groups provided 44% and 2% respectively. The limitations of this source of finance have been documented by Nto [12]. Inadequate capital to provide sustainable capital and non-human development have been known to be responsible for the slow growth of the agricultural sector in developing countries. Unless this problem is resolved through consistent, sustainable and relevant policy instruments, agricultural development in Nigeria will continue to be a mirage [14, 15, 18].

Table 1. Socio-economic characteristics of respondents showing frequencies and percentages.

	Frequency	Mean percentage	Standard deviation
Education			
No formal education	21	21	4.6
Primary education	25	25	2.4
Vocational education	15	15	3.6
Secondary education	36	36	8.4
Higher education	3	3	0.3
Total	100	100	-
Farm size (ha)			
0.05-0.5	75	75	10.2
0.51-0.99	19	19	3.7
1.00 and above	6	6	0.8
Total	100	100	-
Family size			
2-5	29	29	6.4
6-10	50	50	7.1
>10	21	21	5.1
Total	100	100	-
Sex			
Male	46	46	-
Female	54	54	-
Total	100	100	-
Age			
15-30	40	40	6.5
31-45	40	40	4.2
>45	20	20	6.5
Total	100	100	-
Cultivar planted			
Local	15	15	9.0
Improved	85	85	14.5
Total	100	100	-
Source of finance			
Personal savings	54	54	16.2
Family aid	44	44	12.2
Osusu	2	2	0.3
Total	100	100	-

Source : Field survey, 2001.

Results of regression analysis: Three functional forms were estimated, namely linear, semi-log and double-log forms. The respective coefficients are given in Table 2. The results of the specified functional forms are presented in Table 2. It can be seen that R^2 which is the coefficient of multiple determination ranged from 0.78 to 0.86. The F-values ranged from 13.76 to 23.21 for the double-log and linear functional forms respectively. Abang et al. [2] and Markey and Ress [11], in their studies reported that the double log function was most appropriate in explaining allocative and technical efficiencies. This was however, not the case in this study.

The linear function was chosen as the lead equation given the R^2 value of 0.86, the significance level of the coefficients of the explanatory variables and their signs. This agrees with the results

Table 2. Estimated production functions coefficients of cassava using three functional forms.

Functional form	Constant	Coefficients of explanatory variables			R^2	F
Linear	10050.6 (2346.1)	20298.1** (3542.9)	52.2 (53.0)	-54.5** (11.9)	086	23.2**
Semi-log	9.10 (0.26)	2.2** (0.4)	5.2E-3 (0.006)	-6.6E-3 (0.001)	086	23.0**
Double-log	17.5 (2.2)	0.9** (0.2)	0.4 (0.5)	-1.7** (0.5)	078	13.8**

** significant at p< 0.01; * significant at p< 0.05. Values in parenthesis are standard errors

Table 3. Allocative efficiency indices of production resources.

Input	Marginal production (bi)	Price per unit output (Py)	MVP (biPy) (₦)	Price per unit output (Pxi)	Allocative efficiency index
Land (X_1)	20298.1	6.3	126863.3	191.0	664.1
Labour (X_2)	52.2	6.3	326.5	125.0	2.6
Capital (X_3)	-54.5	6.3	-340.6	73.2	-4.7

Table 4. Elasticity of inputs used in cassava production.

Inputs	Elasticities of production (Epxi)
Land (X_1)	0.979
Labour (X_2)	0.352
Capital (X_3)	-1.210

of Yotopoulous and Lau [19] and Agom [4]. The equation is therefore given as:

$$Y = 10050.59 + 20298.13X_{1**} + 52.24X_2 - 54.51X_{3**}$$
$$(2046.14)\quad (3542.87)\qquad (53.04)\quad (11.93)$$

where Y = total output of cassava (kg), X_1 = farm size (ha), X_2 = labour in man-days, X_3 = capital (₦).

The results showed that the three variables were able to explain 86% of the variation in the output of cassava. The coefficients of land and capital were both significant at 99%, though the coefficient for capital had a negative sign, against *a priori* expectation. The coefficient for labour, though not significant, had a positive sign. This means that land size and labour had a direct relationship with cassava output while capital had an inverse relationship with output. The *a priori* expectation of the sign of capital coefficient should be positive. The negative sign is therefore not consistent with the expected logic of the model, which has made the estimated equation suspect. The other two models (semi-log and double-log) did not produce better results. The conclusion here was that capital may have been diverted by the farmers to other uses since resource poor farmers are capital short and therefore the level of use very low, its significance is such an enterprise would also be low. This means that the capital variable would only explain a small proportion of the cassava production model. This result is consistent with that of Agom [4].

Allocative efficiency: This was computed from the regression analysis results and the results are presented in Table 3. The unit prices were obtained by using the harmonic means given by farmers during the questionnaire survey. These were given as: cassava (₦)6.25/kg; land (₦)191.03; labour (₦)125.00; capital (₦)73.20.

Land had the highest efficiency index of 664.10 (Table 3) followed by labour with 2.6 and capital that had a negative value -4.7. This shows that farmers are more efficient in the allocation of land than labour and capital. The results are similar to that of Abang et al. [2]. The implication here is that efficiency can be improved by substituting labour for capital.

Production elasticities: The elasticity of production of the three inputs used are presented in Table 4. This shows that the elasticity for land was 0.979, for labour 0.352 and for capital -1.210. The elasticities for land and labour were inelastic even though that of land as closest to unity implying that it had more influence, when compared to that of labour. Policies that influence land size therefore will greatly influence output of cassava production. Since cassava growers were mostly women, and the age bracket of 15 and 45 years, groups that have been found to be land-short and capital-trapped and as such, policies aimed at redistributing land ownership or its availability to women and the young age bracket farmers could improve cassava production efficiency.

Conclusions and Recommendations

This paper concludes that the small-holder farmers still have a very important role to play in our food security situation in Nigeria. This is derived from the performance of the farmers in the use of resources. The use of land that directly involves the farm size is the singular most important of the variables used in cassava production both in terms of efficiency and elasticity. Policies on land therefore have to be very cautiously handled with a view to increasing output. Since cassava remains one of the most important crops in Nigeria, its production in whatever scale must be encouraged towards the maximization of our limited resources.

Farmers should be encouraged to increase their farm sizes. The effectiveness of the long-standing land use act needs to be reviewed so as to provide a land development policy which will make land easily available to the land-trapped farmers. The provision of infrastructure that will improve land use efficiency through increased access to land to small-holder farmers. Since populations are constantly increasing, a land intensive production package through the adoption of improved technology should be vigorously pursued. The efficiency of use of small resources is a step towards efficiently managing bigger resources. Small-holder farmers should therefore be given greater opportunities to increase production by making laws that will provide more ownership rights to them.

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